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THE CONTRIBUTION OF TECHNOLOGIES, INCLUDING NEW AND EMERGING ONES, FOR THE INDUSTRIALIZATION OF DEVELOPING COUNTRIES AND FOR THE STRENGTHENING OF REGIONAL AND GLOBAL INTEGRATION PROCESSES, INCLUDING PROPOSALS ON WAYS AND MEANS OF TRANSFERRING SUCH TECHNOLOGIES AND FOR THE INCORPORATION IN THE PRODUCTIVE SECTOR OF THOSE COUNTRIES

Contribution of technology to industrialization and regional and global integration

Report of the Secretary-General

SUMMARY

In pursuance of the request to the Secretary-General by the former Intergovernmental Committee on Science and Technology for Development and the Economic and Social Council, this report reviews the impact of global technological and managerial transformations on the economies of the developing countries and the extent to which regional and global economic integration can contribute to those countries' technological modernization and improved international economic performance.

The report emphasizes the need to integrate science and technology policies in developing countries in order to ensure the upgrading of their scientific and technological base and strengthen the linkages between national research and development and private firms. It underscores the new conditions for innovation-driven regional economic integration that have resulted from the globalization of research and development and inter-firm collaborative agreements.

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INTRODUCTION

1. In its resolution 1(XI)B of 3 May 1991, the former Intergovernmental Committee on Science and Technology for Development requested the Secretary-General, drawing upon the work of the relevant organs, organizations and bodies of the United Nations system, to present a report to the Intergovernmental Committee at its twelfth session on the contribution of technologies, including new and emerging ones, for the industrialization of developing countries and for the strengthening of regional and global integration processes, including proposals on ways and means of transferring such technologies and for their incorporation in the productive sector of those countries.

2. The present report has been prepared in pursuance of that request. In addressing the theme, consideration has been given to General Assembly resolution 46/145 of 17 December 1991, in which the Assembly emphasized the importance of activities promoting regional economic integration among developing countries. In particular, the General Assembly recognized the need to support, inter alia, the preparation of studies and implementation of measures to facilitate trade, as well as the harmonization of the macroeconomic policies and legal systems of the countries concerned; and to explore the technological aspects of such industrial reconversion processes as might be economically necessary during the process of integration.

3. The report also takes into account the spirit of General Assembly resolution 46/165 of 19 December 1991, in which the Assembly stressed the importance of national capacity-building for the transfer and adaptation of technology for development and requested the Commission on Science and Technology for Development to submit to the General Assembly at its forty-eighth session concrete proposals for organizing a more effective coalition of resources to meet the scientific and technological needs of developing countries.

4. In addition, the General Assembly, at its forty-seventh session, pursued the discussions on industrial development cooperation and the diversification and modernization of productive activities of developing countries and adopted resolution 47/173 of 22 December 1991, in which it stressed the importance of international cooperation in supporting efforts at the regional, subregional and national levels in industrial development, particularly in the fields of human resources development, investment and export promotion, technology transfer, industrial conversion and development of national capacities, in order to diversify and modernize productive activities in developing countries.

I. BACKGROUND

5. The past 10 years have been characterized by a wide diffusion of new technologies in the areas of micro-electronics, communications, informatics, genetics and materials science which, together with new concepts and processes of management, are completely altering the production of goods and services, encompassing what has been termed a technical and managerial revolution. As a result, important changes have occurred in the structural and educational requirements of the labour force, in the composition and the dynamics of

international trade and capital movements, and in the patterns of international competition. Furthermore, these new and emerging technologies are producing changes in the nature, financial requirements and speed of the process of innovation itself.

6. There has been a growing consensus among development institutions that technological change cannot be separated from a much wider process of social change. The process of innovation or technological change is perceived as an endogenous and cumulative process; endogenous, because the produced technological change is continuously being selected and adapted to the broad needs and requirements of society, and cumulative, because a network of micro-economic relationships establishes effective links between technology creation, technology learning, economic growth and technology accumulation. 1/

7. Attention should be drawn to the fact that, in spite of the pervasive nature of the new technological wave and of the micro-economic rationality of the techno-managerial revolution, the new elements of production and finance have not been converted into stable and constant growth scenarios. In other words, the techno-organizational changes have not yet provided the key conditions for sustainable growth: stable exchange rates, growing opportunities for employment and predictable and consistent rules for world trade.

8. Developing countries are paying a high price for adjusting their economies to these major changes in the international economy. The majority of developing countries have adopted stringent macroeconomic policies to solve fiscal problems, price instability and foreign debt-servicing. As a result, these countries are experiencing difficulties in the upgrading of their technological capabilities, largely due to a dramatic reduction in social expenditures, which has adversely affected their basic educational and research infrastructure.

II. GLOBALIZATION AND TECHNOLOGY: MAJOR TRENDS

9. Historically, technological innovations in areas such as energy, transportation and communications have led to changes in the international location of production and consequently in the patterns of international specialization. The internationalization of goods and services production reached a further stage with the current process of globalization of business and of growing interdependencies among markets, with foreign direct investment as the driving force and transnational corporations as the main instrument. The global reach of international enterprises and the networking of their information systems, which was characteristic of a few industries at the beginning of this century, has become widespread with the application of new information and communications technologies.

10. The greater speed in the transformation of earlier patterns of internationalization has been seen as the result of two interrelated and widespread changes: (a) changes in the institutional and regulatory conditions in money and capital markets with the creation of global financial markets and the globalization of the enterprise structure itself; and (b) the growth of new technologies in the areas of micro-electronics, communications, informatics and materials science. These technologies, in particular, information and communications (telematics) technologies, have facilitated the globalization

process while simultaneously providing further impetus to the process. 2/ This process of globalization has been uneven and has not reached the same levels over all industries and markets.

11. Of these two changes, it is the pervasive nature of advances in micro-electronics, including those in computers and telecommunications, that has been more often associated with the current wave of technological expansion. Overall applications of information technology have totally transformed a diversified array of activities, including finance, banking, business management and public administration, thus enabling the automation of telecommunications and linkages with computers by data transmission. The evolution of information technologies is reflected in significant improvements in performance accompanied by impressive reductions in cost over recent decades, thereby inducing further expansion of micro-electronics and informatics. 3/

12. The implications of globalization for the international system are not yet fully understood. The evidence so far is limited and contradictory. Financial globalization associated with new forms of corporate organization, particularly in research and development-intensive and scale-intensive manufacturing and service industries, has determined higher levels of market concentration. World competition has established world oligopoly as the dominant structure of world markets. Computer, communications and control technologies are permitting transnational corporations to link together production, marketing and research and development facilities on a world-wide scale. Nevertheless, the same technologies are simultaneously permitting greater flexibility and decentralization of operations and market segmentation, thereby providing room for small-sized firms and small economies, albeit in a different context of supplier-client relations. Moreover, the application of these new technologies has allowed small- and medium-sized enterprises themselves to undertake multinational operations.

13. Furthermore, although research and development facilities are still located near corporate headquarters, telematic networks offer opportunities for the internationalization of research and development and for the international sourcing of technological resources through inter-firm cooperation agreements. Most (but not all) of these non-market coordination mechanisms may act as barriers to technology transfer. Inter-firm collaboration in research and development reverses a long tradition of direct appropriation of knowledge through in-house research and development and centralization of these activities in the parent corporation.

14. Developing countries are not necessarily excluded from these knowledge-intensive flows, as has been demonstrated by the successful efforts of many Asian and some Latin American countries. Nevertheless, the emergence of a "virtuous" cycle between the use, growth and accumulation of technology will depend on the ability of a country's institutions to establish the necessary linkages between research institutions and domestic firms, as well as to induce private enterprises to undertake research and development activities. In order to succeed in the global economic environment of the 1990s and move away from non-growth or slow-growth areas, most of the developing countries will need to enforce domestic policies for endogenous capacity-building, with the support of the international community. 4/

A. Globalization and the development process

15. Traditionally, developing countries have been importers of technology. Their prospects for technological transfer, technological development and economic growth in the near future depend not only on domestic but also on the external determinants of capital and technology flows. A review of trends in technology flows in the second half of the 1980s by the United Nations Conference on Trade and Development (UNCTAD) revealed continued growth in the relative importance of capital goods trade and foreign direct investment among developed countries, an acceleration of such flows to a small number of Asian developing countries and only modest improvement (compared with the first half of the decade in their rate of growth in real terms) to the majority of developing countries. 5/ Hence, fears that developing countries may be left at the margin of the current process of technology intensification appear to be substantiated.

16. An important characteristic of the process of technology creation and technology use is its self-reinforcing nature. The process of technological capacity-building offers increasing returns and feeds upon itself, providing further opportunities for technology use, growth and accumulation. The path-dependent character of the innovation process reflects the importance of acquired learning and experience for the building of further learning and experience or, in other words, the dependence of the innovation process on the historical process of technology creation and accumulation. 6/

17. Technology, in economic terms, incorporates the design and production of goods and services, including the various modalities of organizing such production in individual firms and between firms. Technology is embodied in machines, parts and equipment, as well as in human abilities to use existing hardware and to improve it. Technology alone cannot ensure economic prosperity for a nation; for that it is necessary to formulate a set of regulatory and institutional arrangements that will foster the transfer of technological capabilities between and within firms and sectors. The interaction and feedback between social institutions and technologies reflect the cumulative nature of the process of technological change. Technical, economic and social change are inseparable and interdependent components of the same process: the innovation process, the interactive process of technology creation, market experimentation, technology learning and diffusion.

18. The endogenous and cumulative features of the innovation process imply that market forces per se are unlikely to lead a society to higher levels of endogenous scientific and technological capability. On the contrary, given the path-dependent character of technological development, any given situation in time is dependent on the previous one. Unless effective links between domestic private and public institutions and national systems of science and technology have been established, market forces will simply tend to reinforce the existing situation and will not lead a society away from a stagnating or slow-growth position.

19. The spread of innovations in biotechnology and the growth and use of new materials and information technology present both challenges and opportunities for developing countries. A crucial element is the capacity of a country to absorb these new technologies through its industrial, scientific and

technological base as well as though its institutions. Inter-country differences in domestic scientific and technological capabilities and attractiveness to foreign capital and technology suggest therefore that disparities between developing and developed countries as well as among developing countries themselves will tend to increase.

20. Over the past four decades, developing countries have carried out extensive programmes of industrialization that have exhibited various levels of efficiency and incorporation of technical progress. In the majority of developing countries, successful industrialization has resulted in regional and social inequalities and negative environmental effects. Some countries have become competitive exporters of manufactured goods based on abundant natural resources and cheap labour but have not made substantial investments in human resources training and research and development facilities.

21. The diversity of development experience among developing countries permits a better understanding of the forces behind successful industrialization strategies. Several studies undertaken under the auspices of the United Nations have stressed the importance of domestic scientific and technological capabilities and institutions as well as of selective policy instruments. 7/ The analysis of the industrial transformation and of technological and trade performance of the advanced economies of East Asia and of some Latin American countries have further substantiated the strategic role of domestic policies. 8/

22. Recent literature on technological innovation has called attention to the complex combination of private appropriation and public goods aspects involved in the process. It has been remarked that much of the knowledge required to acquire a new technology system, in its early phase, is public knowledge, available in universities. 9/ The current wave of technological transformation has opened opportunities for technological leapfrogging in some areas but is constrained by the limitations of domestic scientific expertise and domestic techno-industrial structure. However, in technologically advanced industries with a high research and development content (for example, pharmaceuticals, chemicals and semiconductors), with concentrated supply structures and greater enforcement of intellectual property rights protection, as well as intensified international technological competition and growing research and development costs, it is extremely difficult for developing countries' firms to acquire new technologies and penetrate these markets.

23. Numerous United Nations documents have underscored the relevance of technological progress for developing countries in the areas of biotechnology, materials and micro-electronics. 10/ Some developing countries possess the necessary skilled scientific and technical personnel to enable the use of sophisticated hardware and scientific knowledge, including, for example, the capacity to apply biotechnology to food and agricultural production, the production of renewable energy, waste recycling, pollution control and medical treatment. For such countries it is crucial to ensure access to the knowledge and hardware produced in developed countries and to build up appropriate linkages between national systems of science and technology and private enterprises. In the near future, countries deprived of skilled human resources and capital will have difficulty competing with new commodity-substituting engineered products in world markets. A similar difficulty may arise from the

creation by industrialized countries of highly engineered materials, such as advanced ceramics, plastics and metallic alloys, composites and superconductors, a development which could undermine the comparative advantage of resource-based exports of developing countries.

B. Globalization and world trade

1. Major changes in the composition and dynamics of world trade

24. Information technology has determined fundamental structural, technological and organizational transformations in most of the industries in developed countries. The key features of these transformations are great product diversity, high productivity and flexibility, due to the development and diffusion of a family of automation technologies, including flexible manufacturing techniques and new products derived from micro-electronics-based control and communications systems. Concerns exist that these transformations will undermine the comparative advantage of those commodity-exporting developing countries that have abundant natural resources and cheap labour.

25. Studies conducted by UNCTAD show that the effect of these changes on the global comparative advantage of developing countries could lead to a shift of production location to the industrialized countries but that this has not yet been reflected in current trade data. In spite of adverse technological change, some developing countries have been able to maintain the competitiveness of their exports. An analysis by the Economic Commission for Latin America and the Caribbean (ECLAC) of countries that increased their share in industrial countries' imports revealed that some of the developing countries in the sample (China, the Dominican Republic, Mexico, the Republic of Korea, Singapore and Thailand) had a predominance of non-traditional manufactured products, which were over two and a half times their exports of natural resources, including petroleum. Another group of developing countries (Brazil, Chile, Costa Rica and Uruguay) was able to increase its share in industrial countries' markets through improved efficiency in the production of mainly traditional lines of goods. 11/

26. Hence, it should be emphasized that attempts to interpret the overall effect of new technologies on trade patterns and international competitiveness remain speculative and should be viewed with reservation.

27. However, a few trends concerning the effect of technological change on production and trade can be asserted. First, the declining raw-material intensity of finished products as a result of resource-saving and an increase in knowledge-intensive innovations, materials substitution, reduced wastage and new and improved methods of processing have contributed to the slower growth or even decline in the international trade of raw materials, including most ores and metals. Secondly, technological change has also influenced the pattern of international trade in manufactured goods. Over the past decade, the most dynamic products have come from highly research-and-development-intensive industries. 12/ The global share of technology-intensive exports increased from 21.5 to 28.6 per cent between 1978 and 1988. 13/

28. Moreover, the most dynamic segments of world trade are intra-industry, meaning those trade flows comprised of goods that are part of the same industry. In addition, capital, goods, technology and services are predominantly traded among industrialized countries. Developed economies accounted for more than 80 per cent of world-wide foreign direct investment inflows in 1990 14/ and for more than 70 per cent of the value of world exports. A large part of these trade flows are also intra-firm; in other words, goods and services are exchanged among different components of the same transnational group.

29. Intra-firm trade is associated with concentrated supply structures but it has also resulted from the activities of transnational corporations, strategies of offshore production and out-sourcing, which have benefited labour-intensive manufactured exports from developing countries. Reductions in the costs of transportation and particularly of information have made possible the shipment of semi-manufactured goods between production sites. For example, stores in the United States of America buy plastic toys from Hong Kong produced in China, based on raw materials shipped from Malaysia; also, integrated chips are fabricated and etched in the United States, assembled in Mexico and re-exported to the United States for final sale. 15/

30. Some developing countries have been able to move out of slow-growing resource-based exports into existing items with a higher value added. Such countries have been able to make the transition and become exporters of technology-intensive manufactured goods. Malaysia, for example, exported technology-intensive goods valued at only $3 million in 1968, but by 1988 that figure had increased to $1.4 billion (at 1968 constant prices). Five developing countries (Brazil, China, Malaysia, Mexico and the Republic of Korea) accounted for 0.8 per cent of world exports of technology-intensive products in 1968 and for 7.2 per cent in 1988. 16/

31. Also, firms in a number of developing countries have succeeded in upgrading skills and technologies and are therefore able to sustain their competitiveness in traditional products. Differences in the level and accumulation of technological capabilities, as well as related organizational and marketing skills, are among the factors that have determined the extent to which countries, especially developing countries, have been improving their trade and growth performance. In such countries as Brazil, China, Colombia, Indonesia, Malaysia and Thailand, and the newly industrializing countries and areas of East Asia, including Taiwan Province of China, firms have demonstrated an ability to rationalize production methods, raise product quality and reduce production costs in medium and low research-and-development-intensive industries. Examples include the development and application of indigenous engineering and design capabilities, and the access of machinery, components and other inputs from foreign suppliers in the higher research-and-development-intensive industries.

2. Major changes in the regulation of world trade: globalization and national policies

32. The rules of the international trading system as summarized in the General Agreement of Tariffs and Trade (GATT) viewed free trade as the ultimate objective and tariffs as the basic instrument of trade policies. Over the first three decades after the Second World War, GATT contributed to the expansion of

world trade, mostly in manufactured goods, by restricting the ability of contracting parties to close off their domestic markets and limit international exchange in response to domestic and international crises.

33. A wide variety of documents prepared by United Nations agencies have drawn attention to trade measures in the developed countries that aim to protect their industries, as well as to their promotion or protection of domestic technology. The globalization of financial markets and corporate structures, combined with the increasingly high proportion of the world output traded among nations, have created new pressures for government intervention to protect a nation's economic well-being; however, the same forces have the potential to constrain such intervention.

34. The globalization of markets, the international convergence of technological capabilities among industrial economies and the growing importance of transnational corporations have created an environment in which relatively small institutional differences and shifts in relative competitiveness can have large effects on international trade and investment flows. Moreover, the industrial development experience in the years since the Second World War, particularly that of Japan and the East Asian economies, has underscored the crucial role of trade and investment policies in the creation of competitive advantage and the allocation of global resources.

35. The globalization of the world economy and competitive forces at the national level have led to pressures for the establishment of new rules in the critical areas of intellectual property rights, foreign investment and services, as well as for the limitation of the use of general policy instruments that could lead to trade distortion effects. These issues were taken up in the Uruguay Round of trade negotiations, launched in 1986 and still in progress.

36. The conclusion of the Uruguay Round would provide a general agreement on trade and services in which the contracting parties would accept, inter alia, uniform and stricter standards of intellectual property rights enforcement, restriction of performance requirements on transnational corporations and the opening up of services sectors. These new regulations could severely affect the prospects for technological and economic development of developing countries and considerably limit their adoption of policy options for promoting the dynamism of their industrial and services sectors.

3. The role of research and development, technology transfer and services for international competitiveness

37. Technological innovation in developed countries and the transfer of technology to developing countries both play a critical role in determining the pattern of world trade and changes in that pattern over time.

38. Technology transfer is a long and expensive process which goes beyond the establishment in a developing country of a plant that uses the latest available technology. Local workers and engineers must be able to understand enough of the technology to deal with all production and maintenance difficulties. The basic theoretical knowledge used in the plant's processes must be fully mastered and that knowledge incorporated into university engineering courses so that it

can be locally reproduced. For technology transfer to be completed, a country must make the necessary infrastructural and institutional changes over a long period, so that an intensive and fruitful learning process can take place in both new and older technologies. Developing countries must undertake infrastructural investment in education, training, research and development and other scientific and technical activities, that is, they must undertake endogenous science and technology capacity-building, if they are to fully realize the benefits of the acquisition of imported technologies.

39. Furthermore, the sustained competitiveness of a country depends on a wide array of capabilities. The ability of a country's firms to generate innovation does not preclude other competitors from bringing to the market improved variations on a new product. The full success of an innovation-driven enterprise depends not only on its lead in commercial markets but on its ability to embody other complementary technological and non-technological assets, such as manufacturing capability and marketing and after-sales services. Countries should be aware that national systems of science and technology must be linked to domestic systems of production and distribution: it is the networking of information and innovation that drives the positive reinforcing dynamics of the economy.

C. Globalization and corporate strategies

40. Enterprises play a central role in the innovation process, since they constitute the basic institution responsible for bringing new technologies to the market in the form of new products or new production processes. The practices adopted by large corporations, as well as their new organizational and managerial structures, will affect both their relations with domestic and international suppliers and the generation and diffusion of technology. Hence, the strategies of large suppliers have a bearing on international location of production and consequently on the dynamics, direction and composition of capital and trade flows.

41. The modern corporation may be seen as a solution to the organizational problems created by the expansion of mass production technology. Mass production requires large investments in sophisticated equipment and highly specialized workers. But the nature of mass production makes it profitable only in markets that can absorb a large volume of a single, standardized commodity or that are stable enough to sustain full employment of the resources committed to the production of that particular commodity.

42. The spread micro-electronics and new management principles that concentrated on quality improvements, control of inventories and higher participation of the labour force made a reversal in mass-production practices possible. This trend is evident in the spatial transformation of old mass-producing industrial plants, as well as in new industries. It has been fostered through the use of flexible equipment by a smaller and less specialized (but more skilled) labour force and in a wide variety of sectors such as capital goods, textiles and apparel. The production capacity of both new and reorganized industries can accommodate customized orders as well as large operations, and deliveries can be programmed to adjust to inventory-saving methods such as "just-in-time delivery".

43. The new system, derived from newly adopted management principles and new technologies (computer-aided techniques and telematics), has a dual dimension. It offers the potential for quasi-integration of corporate operations world wide but also makes greater use of external suppliers to provide many functions, services and products formerly produced within the firm. A greater demand is placed on the suppliers and they also become responsible for many aspects of component and subassembly development, design, production and delivery that were previously defined by the client corporation. These changes in user-producer relationships between firms have affected research and development and product development. For instance, a Brazilian firm, having designed and developed an articulated piston for an American company, in order to satisfy the production requirements of the client had to invest in the construction of a plant in the United States of America. In the 1970s, such a client would have provided a complete specification of the product design. 17/

44. In the past, difficulties in ensuring adequate supervision and control of research and development activities restricted the spread of research and development activities among the components of the transnational corporations group. Despite the fact that transnational corporations prevailed in the most dynamic industrial sectors of developing countries (chemicals, pharmaceuticals, transport equipment and consumer durables, for example), those activities were concentrated within the parent corporation, with practically no research and development activity located in developing countries. The new technologies of information and communication have increased the scope for internationalization of research and development by transnational corporations, although the type of research and development carried out and the extent of its internationalization differs among industries. For instance, the pharmaceutical industry displays one of the most highly internationalized patterns of corporate research and development. 18/ The extent to which firms internationalize their technology-related activities would therefore appear to depend to a large degree on both the technical requirements of the industry and the scientific endowments of countries and affiliates.

45. This globalization of technology-related activities is rapidly affecting the location and organization of innovation; but the effects and implications of globalization on national systems of innovation and on the opportunities and limitations for technology access and transfer cannot yet be ascertained. A recent trend in corporate strategy that has a bearing on the process of technological innovation is the increase in the number of technology-related strategic alliances, inter-firm agreements and network relationships. Inter-firm technology cooperation agreements involve knowledge-production or the sharing of these activities between independent firms. Past research on transnational corporations' strategies has shown that collaborative research and development in foreign joint-venture subsidiaries was rare throughout much of the 1970s.

46. These strategic alliances differ from previous forms of inter-firm agreements, such as joint ventures, subcontracting or licensing agreements, basically because the current modalities of association which bind firms together (a) are more flexible and range from single-project to several forms of non-equity agreements; (b) deal with the dynamics of innovation and competition; and (c) are strategic in the sense that they affect long-term planning objectives. The new forms of agreements provide firms that are facing financial

and economic uncertainty in the world economy with the means to ensure a high degree of flexibility in their operations. The inter-firm agreements have flexible and risk-sharing characteristics that are particularly appealing to firms moving in markets of rapid technological change. Partners in strategic alliances may come from the private or public sectors.

47. In some cases, inter-firm agreements and alliances are instruments of corporate competition strategy and may create implicit protection of key technologies through cooperation among a few enterprises. For instance, research carried out on the partnering activity of 12 European information technology enterprises showed that a European technology-based oligopoly was evolving. 19/ The driving force of these strategic alliances is the tendency of new generic technologies to modify, blur and eventually break down previously well-established boundaries between industries. Therefore, barriers to entry in these industries, to be effective, will have to be built round clusters of technology-related industrial and service activities rather than closely defined industries or product groups. 20/

48. Recent research on international technology agreements during the 1980s showed that the newly industrializing countries and areas of East Asia, including Taiwan Province of China, figured prominently in that period's upsurge of international technology networking. 21/ There are reasons for believing that developing countries may benefit from this movement towards information and innovation networking, particularly through the use of regional mechanisms. Developing countries cannot afford to remain isolated from either these global trends in research and development or the global strategies of transnational corporations.

III. REGIONALIZATION IN THE CONTEXT OF THE GLOBAL DIFFUSION OF THE NEW TECHNOLOGIES: NEW ISSUES

49. The globalization of the international economy is being accompanied by a general tendency to build regional economic and trading blocs. The growth of regionalism is a defining feature of contemporary international economic relations. Although, at first glance, regionalization and globalization appear as contradictory tendencies, in reality they are consistent with one another. Two features are common to both: first, foreign direct investment acts as the driving force; and second, intraregional trade flows are basically of an intra-industry nature. 22/

50. The completion of a single European market became a reality at the beginning of 1993 and has transformed the European Community (EC) into a true common market within which goods, services and factors of production are able to move freely. Another major programme that reinforces regionalization is the European Economic Area, which establishes closer links between the countries of the European Free Trade Association and EC members. The increasing network of agreements between the EC and the remaining European countries suggests the emergence of an essentially integrated market covering most of Europe during the 1990s.

51. Formal and informal trading and investment regions have also been promoted over the past few years, linking developed and developing countries. The most

recent example is the North American Free Trade Agreement, comprising the United States, Canada and Mexico, which succeeded the 1988 United States-Canada Free Trade Agreement. Similarly, investment in Asia by Japanese transnational corporations through regional core-network strategies has forged an investment-oriented Asian integrated area.

52. Initiatives aimed at economic integration among developing countries have also multiplied in recent years; however, these attempts have not been driven by the same motivations as those in the developed countries. In Latin America, members of existing agreements, such as the Central American Common Market, the Latin American Integration Association, and its subgroup the Andean Group, have renewed their efforts to implement free trade areas and other modalities of regional and subregional trade liberalization measures. In South America, Argentina, Brazil, Paraguay and Uruguay have agreed to set up a common market, the proposed Southern Cone Common Market (MERCOSUR), which is in the process of implementing a common external tariff. In the Caribbean area, the Caribbean Community is working on phasing in a common external tariff, while in Africa members of the Organization of African Unity signed a treaty in June 1991 proposing the gradual establishment of an African Economic Community.

53. In Asia and the Pacific, a number of new regional initiatives are under way. In January 1992 members of the Association of South-East Asian Nations (ASEAN) agreed to create a free trade area, to be completed within a 15-year period. Plans have also been announced for a trading zone in north-east Asia. In addition, the heads of 11 Governments met in Istanbul at the end of June 1992 to initiate a Black Sea zone of economic cooperation.

54. The late 1980s and early 1990s witnessed the growth of networking in research and development among firms and research institutes within and across developing regions, the adoption of policies to promote human resource development in the Southern African Development Community (formerly the Southern African Development Coordination Conference) and various modalities of regional and subregional cooperation, which reflected the impact of changes in the competitive strategies of transnational corporations and new development strategies in developing countries implemented since the 1980s.

A. The European experience

55. The European Community is the most highly developed regional arrangement in the international system. It has evolved considerably since the Treaty of Rome was first signed in 1957. From a customs union with six members, it has been transformed into a fully functioning single market with 12 members sharing common micro-economic and macroeconomic policies. European integration has resulted in a significant increase in intra-EC trade flows over and above what would have occurred in its absence. Following the Treaty of Rome, the share of intra-EC exports in total EC exports increased steadily, rising from less than 40 per cent in 1958 to 60 per cent in 1990. 23/

56. One of the most distinctive features of intra-EC trade has been the growth of intra-industry trade. Hence, regional trade liberalization led to specialization within industries rather than movements of resources between industries. Intra-industry flows make up approximately two thirds of European

intraregional trade, consisting primarily of intermediate goods (50 per cent) and capital goods (26 per cent). 24/

57. The EC has launched a series of European research and development initiatives since the early 1980s aimed at decreasing the technology gap between Europe and its two main trading partners, the United States of America and Japan. Existing EC research and development programmes, launched in the early 1980s, have several goals: (a) to ensure that Europe has a domestically generated expertise in major technologies, particularly generic ones such as clean manufacturing techniques and those which are applicable in many different industries; (b) to enable European companies to reap economies of scale in research and development; (c) to spread ideas across national frontiers and promote exchange among scientists; (d) to coordinate national research and development programmes and avoid duplication of effort; (e) to finance research and development programmes which no single Government alone could afford, such as the Joint European Torus, a nuclear fusion programme; and (f) to narrow technological gaps within the EC. 25/

58. Among the most important of the above-mentioned EC initiatives are the European Strategic Programme for Research and Development in Information Technology and Telecommunications (ESPRIT), the research and development programme in advanced communication technology for Europe, the programme to promote the application of modern technologies to traditional industries and the Biotechnology Action Programme. In addition, the European Research Cooperation Agency (EUREKA), an independent research programme, includes another seven non-EC European countries to which the EC contributes. 26/

59. The ESPRIT programme was established in February 1984 by member States of the EC as a 10-year project (two five-year phases) to promote the competitiveness of European industry; it was inspired by the Japanese experience with inter-firm research consortia. Initially, the 12 largest information technology firms were invited to draw up a work programme for their industry. The resulting programme aimed at (a) the promotion of intra-European industrial cooperation in research and development in five main information technology areas (advanced micro-electronics, software technology, advanced information processing, office systems and computer integrated manufacture); (b) the provision of the basic technologies that European industry needs to foster its competitiveness through the 1990s; and (c) the development of European standards. By 1992, a total of 561 such projects were under way or had been completed. Nearly 800 firms and 500 research laboratories in universities and research institutes across the EC took part in the ESPRIT programme. In 1992, for example, ESPRIT claimed credit for more than 700 information-technology prototypes, tools or standards. 27/

60. EUREKA was initiated by France in 1985. As with ESPRIT, its objective is to encourage cross-border collaborative civilian projects between firms and research institutes from different EUREKA member countries, irrespective of size and structure, as a means of strengthening the competitiveness of European industry. Within six years EUREKA had 500 ongoing projects. Unlike ESPRIT, EUREKA has no preselected themes to which prospective consortia must limit themselves. Instead, participants have full responsibility for defining the scope of their collaboration, although EUREKA has from the outset favoured large targeted projects, such as HDTV, designed to develop a new high-definition

television system, and the Joint European Submicron Silicon Initiative, aimed at moving the European semiconductor industry rapidly to the frontier in semiconductor technology.

61. General assessment of these vast EC-funded research and development programmes holds that the overall effect on the European industry has been positive. Mergers, alliances and other forms of collaboration between firms have been promoted through innovative incentives for joint enterprise programmes.

B. Investment-driven integration: the Asian economic experience

62. The loose form of integration in the Pacific is better described by the concept of cooperation than that of integration; the subregional ASEAN grouping is an exception. But despite the absence of a formal regional integration framework, strong linkages already exist among the countries of the region. 28/ Over the past two decades, the Pacific region countries achieved the highest growth performance in the world, averaging 5.4 per cent yearly even in the adverse period from 1986-1990. Technology transfers are being actively pursued in the region and trade patterns are moving steadily towards greater interdependence. The value of intra-trade of the East-Asian countries in 1990 accounted for more than 40 per cent of their total trade (exports plus imports). 29/

63. The basic mechanism underlying increasing interdependence in the Asia and Pacific region is industrial relocation through foreign direct investment, otherwise known as the flying geese pattern of development, which is characterized by the shift of mature industries from early to late-comer industrializers. Two types of enterprises have been engaged in this process of industrial transfer: local and multinational. The trend is forecasted to continue and the ASEAN countries are expected to receive manufacturing production relocated from Japan and the East-Asian countries and areas (including Taiwan Province of China) to the ASEAN countries and China. Interdependence among countries in the region is expected to increase throughout the 1990s, for the following reasons: (a) the inflow of foreign direct investment to the region is expected to increase; (b) most of the foreign direct investment will come from other Asian countries or areas (Japan, Singapore, the Republic of Korea, Taiwan Province of China and Hong Kong); and (c) much of the offshore production will be directed to serving the South-East Asian regional markets. 30/

64. Industrial relocation involves different levels of technology transfer, not only in standardized mature technologies but also in distinct, complementary and more advanced technologies, particularly in industries such as electronics. The degree and success of technology transfer will in the future depend to a larger extent on the technological absorptive capacity of the host country. Most of the new foreign direct investment that Indonesia, Myanmar, the Philippines, Thailand and Viet Nam may expect to receive in the 1990s may still involve relatively simple labour-intensive technology. However, a radio, a children's toy or a tennis shoe manufactured with the present levels of technological expertise will require higher levels of technical production, worker skill and quality control than those currently existing in the industries established

earlier. Foreign direct investment, however, places a burden on the host country to create the necessary conditions to absorb the new technology introduced by foreign companies and to keep up with changes in its comparative advantage over time.

65. Because of this competitive pressure on their export markets, the economies with great export dynamism in South-East Asia have established institutions which specialize in identifying, assimilating and diffusing technologies. In the ASEAN countries, science and technology have been successfully used as key instruments in order to achieve economic integration. In the area of infrastructure, for instance, the ASEAN programme has already established subregional electric grids and common training facilities aimed at the development of human resources. The ASEAN countries have decided to implement an optical-fibre submarine cable network linking member countries, which is due for completion by mid-1994.

C. Regional integration of developing countries

66. Early attempts at regional integration, including free trade areas, customs unions and common markets, were established among countries in Africa, Latin America, Asia and the Caribbean from the late 1950s until to the early 1970s. These initiatives had two elements in common: first, they were conceived as part of a development strategy based on import substitution and mass production of standardized goods; second, they identified small market size as the principal obstacle to the achievement of scale economies in the production of capital, intermediate and durable consumption goods. The rules of the international trading system, enforced by GATT, obliged these agreements to place intraregional trade liberalization (progressing towards full liberalization) at the heart of the integration process.

67. Voluminous literature exists on the meagre results of developing countries' economic integration efforts. Political, institutional and economic arguments have been assembled to explain the reasons why development goals have been achieved by so few of the integration arrangements. A dearth of political will, lack of appropriate institutions which could direct and coordinate integration and a weak private sector have been identified as the key impediments to the realization of successful regional integration schemes in developing countries.

68. Primarily, benefits of free regional trade arrangements tend to affect economies that already have high levels of trade with one another and whose industrial capacity enables trade creation, such as the shifting of trade from a higher to a lower cost supplier. During the 1960s and 1970s, the industrial capacity of developing countries was limited to the manufactures of unsophisticated finished goods and was highly dependent on extraregional imports for technology, machinery and industrial intermediate goods. Moreover, the stage of industrialization of several developing countries in different regions was very similar, requiring high levels of tariff and non-tariff protection. These factors prevented regional liberalization in manufacturing trade, which would have fostered intraregional trade in industrial goods.

69. A further obstacle to the economic integration of developing countries was encountered in the lack of capabilities of local entrepreneurs, owing to the

absence of experience in external markets. Moreover, the principal objective of foreign-owned firms, mostly United States majority-owned foreign affiliates, was market penetration rather than overseas production for exports. On the export side, a large proportion of the licensing agreements between parent firms and their subsidiaries or between licenser and nationally owned local firms contained export prohibiting clauses. On the import side, regional markets were of too little importance to these subsidiaries, as their parent firm or other firms in the home country would be responsible for all of their imports. The combined effect of such strategies on the part of transnational corporations resulted in market segmentation at the expense of integration and protected regional markets at the expense of liberalization. 31/

70. International liquidity, created by the overall increase of oil prices throughout the 1970s, enabled the deepening of the process of import substitution in some developing countries and the strengthening of their domestic entrepreneurial capacity. Moreover, South-South linkages increased over the period through market-determined trade flows. Evidence exists of a higher skill-intensity of South-South manufactured exports relative to South-North trade in the case of selected exports from Argentina, Brazil, India, Mexico and the Republic of Korea, among others. 32/ It has also been demonstrated that by the end of the 1970s and the beginning of the 1980s developing countries were in a position to transfer technology to other developing countries in terms of both technological services and machinery and intermediate goods. Furthermore, firms from developing countries were engaging themselves in international operations, mostly in other developing countries. 33/

71. Technology had only a small role, if any, to play in the traditional exchange-driven or production specialization integration schemes. Countries first had to build up their domestic technological capabilities in order to cope with the requirements for capital, mass markets and the managerial know-how of the system of mass production for standardized manufactured goods. Such technological capabilities were intended to be established within protected national markets and active industrial policies, but not many countries were able to benefit from dynamic economies of scale and from the associated learning processes (learning-by-doing, learning-by-using and learning-by-interacting).

72. The renewal of the interest of developing countries in integration projects that occurred in the 1980s was the direct result of major changes in the economic environment. In particular, the major actors in the international market-place, the transnational corporations, were articulating the need for a different approach to regional integration. As mentioned previously, they were moving towards the development of competitive advantages based on innovation, quality control and close client-supplier relations. In addition, in order to cope with the rising costs of research and development and to reduce uncertainty without adding to the size of the enterprise, transnational corporations were and are increasingly making use of strategic partnerships in research and development and turning their subsidiaries into independent profit centres. 34/

73. These changes created the basis for a quite different rationale for South-South cooperation, moving away from trade as the unique mechanism for achieving economies of scale and scope towards a more dynamic approach in which knowledge,

linkages and flexible structure came to serve as the fundamental building blocks of competitiveness. The innovation-driven model of South-South cooperation would contribute to the launching of the "virtuous" circle of learning and sustainable technological change.

74. In this context, Brazil and Argentina have signed agreements of technical cooperation in the areas of energy, oil, petrochemicals, informatics and biotechnology. The expansion of these bilateral agreements between the two countries to include Paraguay and Uruguay will constitute the Southern Cone Common Market (MERCOSUR). This progress towards a common market, within the context of open trade policies, is providing incentives for its members to upgrade their industries (including agro-industries) in order to meet regional and international competition. The need to improve their international competitiveness is also motivating larger exporting firms in the area to regional outsourcing, as in the case of one important Brazilian textile enterprise, which signed an agreement with a group of Paraguayan textile firms by which the Brazilian firm would transfer production and managerial technology in exchange for Paraguayan cotton and cotton yarn. Furthermore, several joint-venture agreements have been signed by firms from the four MERCOSUR countries.

75. The Arab countries have also promoted the participation of consulting and contracting firms among themselves in project execution, the employment of expatriate manpower and direct investment in most of their large-scale projects. In 1992, Egypt and Saudi Arabia signed an industrial cooperation agreement which may become a model for similar arrangements between Arab and Islamic countries. There is so far no realistic prospect of Middle East regional integration within the pattern of the European Community. However, more limited moves towards economic cooperation in functional areas such as water management, agreements on the creation of regional infrastructure that will facilitate trade within the region and the creation of regional institutions are envisaged in the near future.

76. In Africa, the unfortunate confluence of poverty, undiversified economic structures and political instability has prevented the realization of new modalities of regional integration. Limitations to the free movements of both labour and capital within various regional groupings, as well as poor telecommunications infrastructure, restrict the participation of African countries in the networking of production and information sharing. Nevertheless, electronic networking holds great promise for reducing the isolation of African scientists and engineers. The African Research Information Network project, for example, was recently established, with the objective of promoting regional electronic networking to enhance the communication capabilities of African research, educational and development communities. 35/

IV. POLICY OPTIONS FOR STRENGTHENING NATIONAL ENTREPRENEURSHIP AND ENDOGENOUS SCIENCE AND TECHNOLOGY CAPABILITY

A. Policy options at the national level

77. For many developing countries, the 1980s have been marked by stabilization policies and drastic reductions in public expenditures, especially in public investment. The adoption of structural reforms have not, however, led developing countries back to the growth rates they had achieved in the past. Moreover, these adjustment policies, with few exceptions, have increased the disparities in national income distribution. The response of local firms to liberal trade regimes and new macroeconomic realities has resulted in higher levels of productivity at the expense of manufacturing employment. Unfortunately, liberal trading policies, permitting cheaper foreign imports, which several developing countries have been implementing since the mid-1980s, are virtually eliminating their less competitive domestic industrial sectors, including those characterized by higher technology content, such as electronics and capital goods.

78. Wide intercountry differences exist among developing countries regarding their capacity to absorb and efficiently use new technologies. There are conflicting views on how to overcome the constraints to their absorptive capacity. The liberal interpretation of recent industrial experience in developing countries argues for reduced government intervention, with a restructuring or privatization of State enterprises and neutral functional policies that could cover a wide spectrum of markets, such as trade and investment liberalization, the promotion of internal competition and the provision of physical and institutional infrastructure.

79. The neo-structuralist interpretation, while accepting the importance of functional policies, argues that the successful experiences of industrialization have been those with strategic State intervention in the process of building up endogenous technological capabilities. Moreover, such interventions embrace both functional policies (strengthening market forces without favouring any particular activity or firm over others) and selective policies (promoting particular activities). Nevertheless, the extent and choice of interventions, as well as the degree of efficiency with which they have been carried out, have varied significantly between countries. 36/

80. The experience of developing countries capable of overcoming their technological backwardness has shown the importance of three main factors actively supported by forward-looking State policies: (a) endogenous capability build-up, particularly manpower development at various levels; (b) accelerated introduction of foreign advanced technologies; (c) stimulation of domestic research and development activities through both institutional and legal factors. 37/

81. The technological dynamism of a country is determined by the ability of its enterprises to master process and product technologies, achieve efficient levels of quality, maintenance and operating procedures, adapt technologies to local materials and customer needs, improve technology over time and diversify, innovate and add to the technological base. Such dynamism is further determined by the capacity of the private sector to establish efficient flows of knowledge

and information with suppliers, customers, consultants and science and technology institutions.

82. The process of training, acquiring new information and engaging in experimentation and interaction with other agents requires effort and investment at all levels of operation. Policy interventions are necessary at three interrelated points: (a) to provide incentive structures that induce enterprises to build up capabilities (sound macro-management policies and provision of selective infant industry protection for activities with high learning costs); (b) to develop responsive capabilities for these incentives (policies to develop the skill base, education and training, aimed at the inducement of technology inflows and the promotion of domestic research and development activity); and (c) to provide a variety of institutions supportive of the functioning of markets (in particular, policies to enhance information-transmission mechanisms, active labour-market policies and policies to promote the development of inter-industry linkages through the establishment of networking programmes). 38/

83. There are several areas which should be covered by national technology systems. Policy instruments should aim at the diffusion of technical innovation within national industrial complexes, assist in the creation of a core of basic generic technologies with multiple industrial applications and develop an adequate infrastructure for establishing technical norms and quality control patterns.

84. Several developing countries have succeeded in establishing effective linkages between national science and technology policies and domestic private and public enterprises. In Latin America, examples can be found of the positive results of local efforts and entrepreneurial capability combined with policy measures.

85. In the case of Brazil, a technology programme was designed through which the State-controlled Brazilian petroleum enterprise Petrobrás achieved world technological leadership in deep-water oil drilling. The State-controlled Telebrás (Brazilian Telecommunications) system established a research and development centre in 1976 to develop technical norms for the Telebrás system and transfer equipment technology developed in-house to domestic equipment suppliers. In the field of agricultural research, the State-controlled agency EMBRAPA has promoted productive interactions between the network of research centres throughout the country and the private sector. 39/

86. Participatory relationships between suppliers and clients and partnerships between firms and universities or research institutions proliferated in Latin America during the 1980s. For instance, the Centro para la Inovación Tecnológica (CIT) was established within the National Autonomous University of Mexico in 1983 with the aim of creating links between the university and the productive sector. By the late 1980s, 12 processes or products developed by CIT were already on the market or in their final production stage. The Centro de Gestión Tecnológica e Informática Industrial in Costa Rica, funded by the United Nations Development Programme and the United Nations Industrial Development Organization, has the express purpose of providing the training, technical information and management consulting needed to stimulate small- and medium-

sized firms to act strategically and to incorporate innovation into their growth strategies. 40/

87. Two other examples can be found in Cuba, which has been able to develop a competitive sector of biotechnology through governmental guidance. The Biological Research Centre developed interferon-based products to fight a broad array of diseases, including those arising from hepatitis B and herpes viruses. The Genetic Engineering and Biotechnology Centre, created in 1985, has developed several high-technology products for the agricultural and animal and human health sectors.

88. Most of the Asian developing countries have systematically pursued the upgrading of their scientific and technological base, investing in human resources and providing linkages between the national research and development systems and the private sector by means of a coordinated industrial policy.

89. Singapore has established science and agro-technology parks to speed up the innovation process and particularly to help small- and medium-sized enterprises to improve their business performance through more effective application of technology. The Institute of Scientific and Technical Information of China plays an important role in providing domestic and foreign firms with consulting services on technical and economic information, as well as acting as a broker for various types of technology transactions. 41/

90. The Republic of Korea has established a set of institutions in order to create the necessary linkages between academia and industry, the traditional and the contemporary, and the domestic and the foreign. First, the Korean Institute of Science and Technology was created as an independent, multidisciplinary industrial research institute for those purposes. Second, the information clearing-house for industrial research was reinforced. Third, quality control and instrument calibration service centres were established as short-term measures in selected areas of industry. As a long-term measure, the Korea Standard Research Institute was reorganized to support industry in this regard. 42/ In addition to the creation of innovation-supporting institutions, particular industries were selected whose technological development was promoted through effective interaction between public and private sectors.

91. In contrast to the above examples, the major systemic constraint to development in most developing countries remains the weak interaction between financial services, educational and manpower policies, investment programmes and technology policies. Furthermore, linkages between the public and private sectors are ill-defined and disjointed.

92. In most regions, developing countries with entrepreneurial capacity and national science and technology institutions are in a better position to transfer technology to other developing countries, either through inter-firm collaborative agreements or through intergovernmental regional and subregional cooperation agreements. In addition, in regions with a lower and less sophisticated entrepreneurial structure, regional and subregional initiatives may be instrumental in pooling together scarce scientific, technological, financial and institutional resources to promote the establishment of the

necessary internal linkages. Regional integration presents a suitable mechanism for the achievement of such efforts.

B. Policy options at the regional and subregional levels

93. Important changes have occurred in the trade policies of developing countries that are leading to higher levels of outsourcing by domestic enterprises, which will result in the expansion of trade. Additionally, the opening up of previously protected markets, as in the case of Latin America, is leading to changes in the strategies of foreign subsidiaries in the region. Open markets in Latin American countries allow for the possibility of productive relocation of foreign subsidiaries to their most efficient operations. This trend towards arms-length operations and externalized production is already evident in the case of Brazil and Mexico, enabling small- and medium-size enterprises to form inter-firm linkages. This type of model of industrial organization leads to increasing specialization of parts and components or subassemblies. In the case of Asian countries, cross-border subcontracting networks which link small- and medium-sized enterprises from different countries to an enlarged network of domestic and foreign firms have become standard practice.

94. Therefore, market and firm-determined intraregional and intraindustrial specialization replaces the industrial specialization brought about by intergovernmental agreements which characterized the regional integration schemes of the 1960s and 1970s. The previous practice of target planning, at the regional and subregional levels, is thus replaced by the creation of innovation networks aimed at the promotion of complementarities between countries through inter-firm collaborative agreements. It is important to recall, however, that initiatives at the regional and subregional levels must recognize the fact that the technological innovation process requires a whole array of non-market services, such as information acquisition and dissemination, training and financial services.

95. The challenges of the technological innovation process are better met through regional arrangements which facilitate access to firms with complementary assets within the region. Hence, it is important to count on mechanisms and instruments of regional reach that favour the access of enterprises from a given country to technological experiences and know-how existing in enterprises and institutions of another country of the region, or alternatively, that favour the establishment of technological development projects among enterprises and research institutions of countries outside the region.

96. The European experience with such innovative programmes as EUREKA and ESPRIT may be an interesting starting point for policy options aimed at the strengthening of entrepreneurship and endogenous scientific and technological capabilities at regional and subregional levels.

97. Regional development banks will play a crucial role in the financing of network systems for linking national systems of science and technology with productive sectors as well as enhancing the regional integration of science and technology. Innovative financial products, such as subsidies, special loans,

risk capital and insurance, are also critical for the creation of incentives, particulary at the early stages of innovation projects.

98. Such regional programmes would encourage cooperation between enterprises, research centres and public and private bodies, and would help to foster a new system of relationships between the scientific, technical and industrial sectors. Their main objectives would be: (a) to improve the quality of products, processes and services in order to open new markets; (b) to attain homogeneous international quality standards; (c) to generate new products, processes and services that are commercially practicable; (d) to establish joint ventures with enterprises and institutions of two or more countries within or outside the region; and (e) to strengthen the productive capacity existing in each country of the region.

99. An example of a creative mechanism for integration along those lines is the Bolívar Programme for Industrial Technological Integration, Innovation and Industrial Competitiveness, financed by the Inter-American Development Bank (IDB). This programme pursues the establishment of institutional and financial mechanisms for the promotion of regional technological cooperation through joint projects, with the active participation of private sector enterprises and research centres. The programme was formally launched in March 1992 with the strong support of Latin American Governments and with technical and financial support from IDB. It has been compared to the European programme EUREKA as a simple and flexible cooperation mechanism for establishing scientific and technological linkages between productive sectors and research centres of Latin America.

100. Another important area for regional cooperation is the establishment of compatible intellectual property rights regimes. Efforts in that direction have already been made in some subregional schemes such as the Andean Group, as well as in the MERCOSUR and the Latin American Economic System. The objective of such regional cooperation is to build on the expertise in intellectual property rights that exists in countries of the region and to promote standards suitable to the development process while complying with international standards. Mechanisms should be created at regional and subregional levels to stimulate the exchange of information among scientists, entrepreneurs and policy makers on the implications of changes in the systems of intellectual property rights for the access of developing countries to new and strategic technologies. Moreover, countries should exchange experiences and knowledge in the management of intellectual property rights, in order to establish a regional system in the area of intellectual property (or patents) that would provide incentives for innovation without limiting the diffusion of innovations throughout the productive apparatus.

101. The growth up of endogenous innovative capability is a long-term process which results in the creation, mastery and use of modern science and technology. Long-term commitments are necessary to establish centres of excellence in universities and research institutes and provide scientific communities with adequate infrastructure, scientific literature and financial resources. Moreover, in the majority of developing countries, long-term investments in human resources, starting with preschool education, are needed in order to break the chain of poverty and technological backwardness.

102. The ultimate objectives of the technological innovation process are to increase the quantity and quality of goods and services available in the economy and to improve the access of the majority of the people to the benefits of technical progress. Growth and social equity are therefore interdependent objectives, and efforts must be made to advance towards these two objectives simultaneously rather than sequentially. 43/

103. There is increasing awareness among countries that the current move towards globalization represents a major reversal in the traditional pattern of industrialization. At present, although transnational corporations represent a large concentration of financial assets in single firms, production has become globally diffused. Information and communications technologies have enabled the concentration of supply while allowing for the increasing tendency to subcontract the production of component parts.

104. In particular, developing countries are concerned about their participation in the new client-supplier relations which have emerged owing to the ongoing interactive process between technological and organizational change.

105. Essentially, regional cooperation and technological innovation are mutually supportive and interdependent processes. Regional and subregional integration can foster technological innovation within the region, and, vice versa, technological innovation can foster regional integration by increasing the scope for internationalized activities.

106. There is much scope for international cooperation at the regional, subregional and interregional levels with a view to increasing efficiency in the use of scarce scientific, technical, entrepreneurial and institutional resources, as well as to promoting inter-firm regional collaborative agreements for improving the international competitiveness of developing economies.

Notes

1/ Organisation for Economic Cooperation and Development, Technology in a Changing World (Paris, 1991), pp. 46-47.

2/ Organisation for Economic Cooperation and Development, Economy and Technology (Paris, 1992), chap. 10, pp. 209-236.

3/ See "Substantive theme: impact of new and emerging areas of science and technology on the development of developing countries" (A/CN.11/80, 22 May 1987); Overall Socioeconomic Perspective of the World Economy to the Year 2000 (United Nations publication, Sales No. E.90.II.C.2), chap. VI, pp. 101-131.

4/ See "New developments and trends in the programmes and activities of the United Nations system in science and technology for development" (A/CN.11/1991/5, 14 March 1991).

5/ United Nations Conference on Trade and Development, "Transfer and development of technology in a changing world environment: the challenges of the 1990s" (TD/B/C.6/153, 25 January 1991), pp. 2-5.

6/ As Soete says, more generates more. See Luc Soete, "Opportunities for and limitations to technological leapfrogging", in Technology, Trade Policy and the Uruguay Round (United Nations publication, UNCTAD/ITP/23, 1990), pp. 3-29.

7/ See Advanced Technology Assessment System (ATAS) Bulletin, (United Nations publication, various issues), for further reference.

8/ United Nations Conference on Trade and Development, "Transfer and development of technology ...", chap. II.

9/ Luc Soete, loc. cit., p. 17.

10/ See, for example, Trade and Development Report, 1987 (United Nations publication, Sales No. E.87.II.D.7) and Industry and Development: Global Report 1989/90 (United Nations publication, Sales No. E.89.III.E.5).

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16/ World Bank, op. cit., p. 33.

17/ Economic Commission for Latin America and the Caribbean, op. cit., p. 123.

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19/ Lynn Mytelka, "New modes of international competition: the case of strategic partnering in R&D", Science and Public Policy, vol. 17, No. 5 (October 1990), p. 300.

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22/ Louka T. Katseli, "Foreign direct investment and trade interlinkages in the 1990s: experience and prospects of developing countries", paper prepared for the United Nations Centre on Transnational Corporations under the project "The new globalism and developing countries: investment, trade and technology linkages in the 1990s".

23/ André Sapir, "Regional integration in Europe", The Economic Journal, vol. 102, (November 1992), p. 1493.

24/ Paul Rayment, "Comment", Journal of Development Planning, No. 21 (1992), p. 65.

25/ "Europe's technology policy", The Economist, 9 January 1993, p. 19.

26/ The other countries are Austria, Finland, Iceland, Norway, Sweden, Switzerland and Turkey.

27/ Lynn Mytelka, "States, strategic alliances and international oligopolies: the European ESPRIT programme", in Mytelka, ed., op. cit., pp. 181-210.

28/ The following countries are members of ASEAN: Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore and Thailand. The Lao People's Democratic Republic and Viet Nam have expressed interest in joining the Association.

29/ Ippei Yamazawa, "On Pacific economic integration", The Economic Journal, vol. 102 (November 1992), pp. 1519-1523.

30/ Linda Y. C. Lim, "Foreign investment, trade and technology linkages in the Pacific Asian developing countries in the 1990s", paper prepared for the United Nations Centre on Transnational Corporations under the project "The new globalism and developing countries: investment, trade and technology linkages in the 1990s", January 1992, pp. 5-7.

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32/ Vivianne Ventura-Dias, ed., South-South Trade, Historical Trends and Obstacles to Its Growth (New York, Praeger, 1989).

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